Factors associated with functional recovery and home discharge in stroke patients admitted to a convalescent rehabilitation ward

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Abstract
Aims: This study aimed to determine the predictive factors for functional recovery and home discharge in stroke patients receiving in-hospital rehabilitation.

Methods: This study included a consecutive series of 174 stroke patients (average age 73.0 ± 10.8) admitted to the convalescent rehabilitation ward at Azumino Red Cross Hospital in Japan after acute rehabilitation. The main outcome measures were functional recovery (functional independence measure [FIM] at discharge and Montebello rehabilitation factor score [MRFS]) and home discharge.

Results: Total FIM improved from 72.6 ± 27.6 to 87.7 ± 29.9 during the hospital stay ($P < 0.001$). The average MRFS was 0.34 ± 0.31. Of the 174 patients, 151 were discharged home (87%). Age, stroke type, premorbid independence, motor FIM, and cognitive FIM at admission showed a significant association with FIM at discharge, while age, premorbid independence, motor FIM at admission, and cognitive FIM at admission were statistically significant predictors of MRFS. Female sex, not living with family, premorbid independence, and neglect were negatively associated with home discharge.

Conclusions: Premorbid disability and cognitive dysfunction at admission were both negatively associated with functional recovery and home discharge in patients undergoing inpatient stroke rehabilitation. Geriatr Gerontol Int 2012; 12: 215–222.

Keywords:
elderly, functional independence measure, predictors, rehabilitation, stroke.

Introduction

Stroke is a leading cause of acquired disability and a frequent cause of death, and its incidence increases with age.[1,2] Most neurological and functional recovery occurs within the first 6 weeks after onset of stroke and continues for several months. Maximal functional recovery is usually achieved within 6 months.[3] Early post-stroke rehabilitation effectively improves physical function, activities of daily living (ADL), and independence.[4–6] Patients with mild stroke are usually discharged home within a short period after the onset of stroke and use community-based rehabilitation services or primary health services.[5,6] However, a substantial number of patients with moderate to severe stroke, especially those in need of intensive rehabilitation, are admitted to a specialized ward for rehabilitation, where they stay for several months after acute stroke rehabilitation.[7–10] In Japan, the convalescent rehabilitation ward plays an important role in the rehabilitation of these patients after the acute phase.[11] According to the medical service law, a convalescent rehabilitation ward is "a ward for intensive rehabilitation based on a rehabilitation program co-created by physicians, nurses, physical therapists, and occupational therapists, to prevent a bedridden state and to promote home rehabilitation by improving ability to perform ADL in patients with cerebrovascular disease, hip fracture, and so on."[12] Patients with cerebrovascular disease are admitted to the convalescent rehabilitation ward within 2 months of onset of disease, and the maximum length of stay is limited to 5 months (6 months if the patient has higher brain dysfunction). In addition to the sequelae of stroke, most patients admitted to the convalescent rehabilitation ward are elderly and often suffer from multiple comorbid medical complications or an age-related decline in functional status.[7,8] It is a challenge to improve functional status and independence in such patients during this limited period and to plan discharge. Clarifying the factors that may predict successful functional recovery and discharge destination would help ensure that the relatively long-term and expensive in-hospital rehabilitation is more effective.

Possible predictive factors associated with post-stroke functional recovery and discharge destination include functional status at admission,[13–15] age,[9,13–16] female sex,[17,18] lesion type,[19] continence,[15,20] cognitive impairment,[21,22] premorbid independence,[21,23–25] available social network,[10,26] and care giving resources.[14,15,17,21–23] However, these predictive factors have varied with the settings of studies and inclusion criteria for subjects (i.e. stroke units specializing in acute stroke patients or convalescent rehabilitation wards specializing in rehabilitation of patients after the acute phase).[9,13–17,19,21–25] Few studies have been conducted on the efficacy of long-term inpatient stroke rehabilitation in the convalescent rehabilitation ward setting in Japan.[11–13] This study evaluated the rehabilitation outcomes, functional recovery, and discharge destination in stroke patients in a convalescent rehabilitation ward.

Methods

Setting

The convalescent rehabilitation ward at Azumino Red Cross Hospital is a 45-bed unit that employs a multidisciplinary team approach. All the patients received physical therapy and occupational therapy for 5–6 h a week; if their condition was complicated by aphasia and/or dysphagia, these patients received speech therapy for 5 h a week. A team conference, in which the patient, family members, physician, hospital staff, and a social worker participated, was held once a month to evaluate the status of the patient and discuss treatment plans and discharge destination. When a decision was reached to discharge the patient home, both the physical therapist and occupational therapist visited the home and provided detailed counseling on home modification measures and assistive devices. Most patients (approximately 90%) admitted to the convalescent rehabilitation ward had been referred from the department of neurosurgery or neurology of the same hospital, while the rest were from neighboring hospitals.

Participants

The study included 174 consecutive stroke patients admitted to the convalescent rehabilitation ward from January 2006 to June 2008 (average age 73.0 ± 10.8; 89 male and 85 female patients). All subjects were admitted to the ward within 2 months of onset of stroke (average, 33.5 ± 18.6 days). Patients with severe confusion, unstable medical complications, or other acute diseases that could impede active rehabilitation were not included in the study.

Assessment

A series of parameters collected at the time of admission were examined to obtain factors that could predict functional recovery as evaluated by the functional independence measure (FIM)[27,28] and the probability of home discharge. The following information was collected from the Azumino Red Cross Hospital convalescent rehabilitation ward database and medical records: age, sex, length of stay, discharge destination (discharged home, transferred to another hospital, transferred to a facility), prestroke living situation (alone, with spouse, or living with two or more generations of family), medical complications (hypertension, atrial fibrillation, diabetes mellitus), history of stroke onset (first time or relapse), premorbid ADL status (according to the modified Rankin scale: independent 0–2; dependent 3–5), stroke type (ischemic or hemorrhagic), Brunnstrom stage at admission (sum of scores at the upper limb, fingers, and lower limb), visual deficit (including cataract, glaucoma, hemianopia, multiple vision, and ocular motility disorder), neglect, and urinary incontinence.

Functional disability was assessed using FIM. The FIM was evaluated for each subject within 48 h of admission and no more than 48 h from discharge. The FIM can measure both physical and cognitive disability. Thirteen items comprise the motor subscale (motor FIM) with the remaining five items comprising the cognitive subscale (cognitive FIM). The items on the FIM are scored on a seven-point ordinal scales based on the amount of assistance required. The minimum score on the FIM is 18, which indicates a low level of functioning; the maximum score is 126, which indicates a very high level of functioning. The degree of functional recovery was obtained from the FIM score at admission and discharge and Montebello rehabilitation factor score (MRFS) (discharge FIM – admission FIM)/(maximum possible FIM – admission FIM), indicating the degree of improvement.[29]

Statistical analysis

All statistical analyses were performed with SPSS software for Windows release 18.0 (IBM Japan Ltd., Tokyo, Japan). The Student's t-test was used for quantitative variables when comparing the means of two groups. The χ^2 and Fisher's exact tests were used to test the significance of the association between two qualitative variables. Multivariate logistic regression analysis with forward selection method (Wald) was used to determine the predictors of home discharge. A stepwise multivariate linear regression analysis was applied to determine the predictors of FIM at discharge and MRFS. In all the analyses, a P value <0.05 was considered statistically significant. The variance inflation factor was also estimated.

This study was approved by the Ethical Review Board of Azumino Red Cross Hospital and the Ethical Committee of Shinshu University.

Results

The average age of the subjects was 73.0 ± 10.8 years, and 48.9% were female. Records of history of onset indicated that 67.8% were admitted with their first episode of stroke, and 60.9% subjects had suffered from an ischemic stroke. Analysis of premorbid ADL status revealed that 24.7% of the patients were dependent. Brunnstrom stage at the time of admission was 16.0 ± 4.0. Clinical symptoms and their frequency were as follows: visual deficit 14.9%; urinary incontinence 38.1%; and neglect 10.9% (Table 1).

FIM scores, which were used to assess functional recovery, improved: total FIM (from 72.6 ± 27.6 to 87.7 ± 29.9), motor FIM (from 50.1 ± 21.3 to 62.9 ± 23.0), and cognitive FIM (from 22.4 ± 8.3 to 24.7 ± 8.2). Total FIM gain was 15.1 ± 15.6, motor FIM gain was 12.8 ± 13.0, and cognitive FIM gain was 2.3 ± 3.7. The average MRFS was 0.30 ± 0.28 (Table 2).

A total of 151 patients were discharged home (87%) 12 patients were transferred to nursing facilities (7%), and 11 patients were transferred to other hospitals (6%). There were significant differences between the home discharge group and the group that was unfit for home discharge with regard to sex, premorbid ADL status, Brunnstrom stage, urinary incontinence, neglect, scores for all FIM items at admission and discharge, FIM gain, and MRFS. There was no significant difference between the groups with regard to age, medical complications, type of onset, type of stroke, and length of stay (Table 3).

A multivariate stepwise linear regression analysis was undertaken to determine which variables were the best predictors of functional recovery. FIM at discharge and MRFS were used as the dependent variables. The independent variables included age, sex, living situation, medical complications, history of onset, premorbid ADL, stroke type, Brunnstrom stage at admission, motor FIM at admission, cognitive FIM at admission, and the presence of neglect, visual deficit, or incontinence. Total FIM at discharge was predicted on the basis of age (β coefficient = −0.12, $P = 0.003$), ischemic stroke type (β coefficient = 0.09, $P = 0.005$), premorbid ADL status (β coefficient = 0.16, $P < 0.001$), neglect (β coefficient = −0.10, $P = 0.001$), motor FIM at admission (β coefficient = 0.37, $P < 0.001$), and cognitive FIM at admission (β coefficient = 0.46, $P < 0.001$). MRFS was predicted by age (β coefficient = −0.22, $P = 0.003$), premorbid ADL status (β coefficient = 0.25, $P < 0.001$), motor FIM at admission (β coefficient = −0.28, $P = 0.003$), and cognitive FIM at admission (β coefficient = 0.56, $P < 0.001$). The variance inflation factor was estimated to exclude the possibility of overlap between highly correlated independent variables. Values between 1.01 and 2.31 denote no collinearity between the variables (Table 4).

A multivariate logistic regression analysis was undertaken to determine which factors were the best predictors of home discharge. Home discharge was used as the dependent variable. The independent variables included age, sex, living situation, medical complications, history of onset, premorbid ADL, type of stroke, Brunnstrom stage at admission, motor FIM at admission, cognitive FIM at admission, the presence of neglect, visual deficit, or incontinence. In this model, motor and cognitive FIM were used as independent variables. There was a statistically significant association between home discharge and female sex (OR = 0.13; 95% CI 0.03–0.50; $P = 0.003$), living with family (OR = 23.25; 95% CI 3.79–142.56; $P = 0.001$), premorbid ADL status (OR = 0.09; 95% CI 0.02–0.37; $P = 0.001$), neglect (OR = 0.04; 95% CI 0.01–0.27; $P = 0.001$), and cognitive FIM at admission (OR = 1.12; 95% CI 1.03–1.22; $P = 0.010$) (Table 5).

Discussion

In the present study, we found that intensive inpatient rehabilitation in the convalescent rehabilitation ward successfully alleviated disability in elderly patients with stroke and led to relatively favorable functional recovery. Most of the subjects (87%) were discharged home. During the stay in the rehabilitation ward, functional recovery was observed on all counts: total FIM, motor FIM, and cognitive FIM. There were significant differences between the total FIM and motor FIM at admission and at discharge, but the same was not true of the cognitive FIM. The results indicate that functional recovery depends most on improvement of motor function. The MRFS was 0.30, indicating that treatment efficacy was similar to that previously reported.[22,30,31]

Functional status was assessed by FIM, which has the highest reliability and validity among ADL evaluation methods and is widely used in rehabilitation settings.[16,22,32–35] Absolute FIM gain (the difference between the value at the time of discharge and hospitalization) is often used to quantify the outcome, but this index has a ceiling effect (when FIM at hospitalization is high, FIM at discharge is high with small gain). Therefore, we also used MRFS, which is the relative FIM gain at discharge, to determine the efficacy of rehabilitation.[22,30,31]

Multivariate stepwise analysis revealed that age, premorbid disability, ischemic stroke, neglect, motor FIM, and cognitive FIM at admission were predictors of FIM at discharge, while MRFS was predicted by age, premorbid disability, motor FIM, and cognitive FIM at admission. In accordance with many previous studies, FIM at admission proved to be the single strongest factor that could predict FIM at discharge.[16,22,32–34] Furthermore, we found that cognitive FIM at admission predicted both FIM at discharge and MRFS.[22,30,31] In line with several previous studies, this study indicated that cognitive status at admission influences functional outcomes in elderly stroke patients. It is noteworthy that the association between cognitive dysfunction and functional recovery is not specific to patients with stroke, and is also seen in non-central nervous system disorders, such as hip fractures.[36] This may be because cognitive dysfunction at admission could make it difficult for patients to understand the context of rehabilitation programs or follow instructions. Additionally, the presence of a cognitive disorder may represent a dysfunction in the central nervous system, which would have an impact on neuroplasticity or the extent of reorganization in response to therapy.[37] For the successful rehabilitation of stroke patients with cognitive dysfunction, it may be effective to use more comprehensive programs focusing on cognitive function intensity over a longer period.

The present study revealed that premorbid disability and age were significant predictive factors for functional recovery.[18,21,32,38] Counsell *et al.* developed and validated the accuracy of a simple predictive model with six variable factors collected shortly after the onset of stroke, which could predict the probability of a patient being alive and independent at 6 or 12 months after the stroke.[24,25] The six simple variables were age, living alone, prestroke independence, a normal Glasgow Coma Scale verbal score, the ability to lift arms, and the ability to walk. Brauer *et al.* reported that age and prestroke residential status in combination with gait and rolling ability were highly predictive of home discharge from the rehabilitation facility.[24,25,39] Premorbid disability could be a result of various kinds of physical and mental dysfunction, such as medical complications, frailty due to old age, pre-existing disability, and cognitive dysfunction.[19,30,40] When combined with the insult due to stroke, premorbid disability causes further functional decline and may thus be a negative predictor for recovery and home discharge.

Multivariate regression analysis revealed that female sex, living with family, premorbid disability, and neglect were associated with a lower possibility of home discharge. Several previous studies have reported that female sex is a possible predictive factor that could decrease the likelihood of home discharge.[17,41] Several studies have suggested that female stroke patients show relatively less improvement than males in response to rehabilitation, but this sex difference is controversial.[41–43] We speculate that the factors that lower the rates of home discharge for female patients may be social rather than biological. For instance, this study consisted of many elderly subjects with stroke and the spouses of female patients were often older than the patients themselves or already deceased; thus, female patients with stroke often lacked close family members or informal caregivers. This study also demonstrated that living with more than two generations of family is a strong predictive factor for home discharge. It is recommended that social issues be included in outcome studies for stroke.[10,14–17,21–26] In Japan, care resources that are available as alternatives to family members or informal caregivers are insufficient. When supporting chronically ill or frail people in the home, the presence of a suitable caregiver is crucial. When one cannot be secured, it is necessary to examine available home care support, and thus look for possibilities for home discharge.

We found that among the clinical variables noted at admission, neglect was the one that prevented home discharge. Presence of neglect lessens functional recovery and decreases the home discharge rate.[21,44,45] Katz *et al.* investigated stroke patients with right-hemisphere damage and found that patients with neglect had longer intervals between stroke onset and admission to the rehabilitation ward, showed slower functional recovery, required a longer hospital stay, and had lower home discharge rates than patients without neglect.[46] This concurs with our results; the presence of neglect at admission into the rehabilitation ward suggests poor rehabilitation outcomes.

Previous studies have investigated functional recovery in elderly first-time ischemic stroke patients.[21,22,32–34,40] A potential source of bias in the present study is that our cohort contained a relatively high proportion of hemorrhagic stroke patients (39.0%), as a large number of our patients were referred from the neurosurgery department. Furthermore, ours was a consecutive series of stroke patients with a high average age, many of whom had cognitive dysfunction, and 32% of whom had had a recurrence. In fact, many patients with recurrent stroke are hospitalized in the rehabilitation ward, which is probably why premorbid disability and cognitive dysfunction were found to be negative predictors of home discharge and functional recovery in this study. Possible predictive factors for the success of rehabilitation may differ depending on the study setting or the inclusion criteria. This study was relatively short-term, investigating outcomes within 1 year of onset, and further long-term studies, including those that investigate functional outcome and mortality rate, are necessary. Considering the complexity of rehabilitation in elderly patients with stroke, collection of more detailed data and further studies would improve the prediction of functional recovery.

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Table 1 Demographics and clinical characteristics of patients at admission

General characteristics		($n = 174$)
Age at admission	Mean age ± SD	73.0 ± 10.8
Gender	Male/Female	89/85
Living situation	Alone	14
	With spouse	44
	With family	116
Medical complication	Hypertension (No/Yes)	81/93
	Atrial fibrillation (No/Yes)	155/19
	Diabetes mellitus (No/Yes)	146/28
Onset	First/Recurrent	118/56
Stroke type	Ischemic/Hemorrhagic	106/68
Premorbid independence (premorbid mRS 0–2)	Yes/No	131/43
BRS	Mean (SD)	16.0 ± 4.0
Visual deficit	No/Yes	148/26
Incontinence	No/Yes	106/68
Neglect	No/Yes	155/19

BRS, Brunnstrom stage (sum of scores at the upper limb, fingers, and lower limb); mRS: modified Rankin Scale.

Table 2 FIM score during inpatient rehabilitation

FIM	Admission	Discharge	FIM gain ($n = 174$)	MRFS ($n = 174$)
Total	72.6 ± 27.6	87.7 ± 29.9	15.1 ± 15.6 *	0.34 ± 0.31
Motor	50.1 ± 21.3	62.9 ± 23.0	12.8 ± 13.0*	0.30 ± 0.28
Cognitive	22.4 ± 8.3	24.7 ± 8.2	2.3 ± 3.7	0.22 ± 0.31

* $P < 0.001$. FIM, Functional Independence Measure; MRFS, Montebello Rehabilitation Factor Score (Discharge FIM – Admission FIM)/(Maximum possible FIM – Admission FIM)

Table 3 Comparison of patient characteristics according to discharge destination

General characteristics		Discharge destination: Home ($n = 151$)	Discharge destination: Facility/hospital ($n = 23$)	P
Age at admission	Mean age ± SD	72.7 ± 10.4	74.9 ± 13.0	0.442
Gender	Male/Female	83/68	6/17	0.010
Living situation	Alone/With spouse/ With family	9/36/106	5/8/10	0.010
Medical complication	Hypertension (No/Yes)	69/82	12/11	0.562
	Atrial fibrillation (No/Yes)	134/17	21/2	0.714
	Diabetes mellitus (No/Yes)	125/26	21/2	0.378
Onset	First/Recurrent	101/50	17/6	0.502
Stroke type	Ischemic/Hemorrhagic	90/61	16/7	0.362
Premorbid independence (premorbid mRS 0–2)	Yes/No	121/30	10/13	<0.001
BRS	Mean ± SD	13.0 ± 4.0	11.0 ± 3.8	0.031
Visual deficit	No/Yes	129/22	19/4	0.754
Incontinence	No/Yes	100/51	6/17	<0.001
Neglect	No/Yes	139/12	16/7	0.001
FIM admission	Mean ± SD			
Total		75.7 ± 27.2	52.0 ± 22.4	<0.001
Motor		52.4 ± 20.9	35.2 ± 18.3	<0.001
Cognitive		23.3 ± 8.2	16.8 ± 6.2	<0.001
Discharge				
Total		91.8 ± 28.0	60.3 ± 27.7	<0.001
Motor		66.2 ± 21.4	41.7 ± 21.9	<0.001
Cognitive		25.7 ± 7.9	18.7 ± 7.4	<0.001
FIM gain	Mean ± SD			
Total		16.1 ± 16.0	8.4 ± 10.3	0.004
Motor		13.7 ± 13.3	6.5 ± 7.9	0.001
Cognitive		2.4 ± 3.9	1.9 ± 3.0	0.489
MRFS				
Total		0.37 ± 0.31	0.15 ± 0.21	<0.001
Motor		0.33 ± 0.28	0.12 ± 0.15	<0.001
Cognitive		0.23 ± 0.33	0.14 ± 0.22	0.102
Length of stay	Mean ± SD	58.4 ± 40.8	50.5 ± 34.4	0.324

BRS, Brunnstrom stage (sum of scores at the upper limb, fingers, and lower limb); mRS, modified Rankin Scale; FIM, Functional Independence Measure; MRFS, Montebello Rehabilitation Factor Score.

Table 4 Multivariate stepwise regression analysis for functional recovery

General characteristics	FIM at discharge		MRFS	
	Beta coefficient (*P*)	VIF	Beta coefficient (P)	VIF
Age at admission	–0.12(0.003)	1.20	–0.22 (0.003)	1.15
Gender	NS		NS	
Living situation	NS		NS	
Medical complication	NS		NS	
Onset	NS		NS	
Stroke type	0.09 (0.005)	1.01	NS	
Premorbid independence	0.16 (<0.001)	1.20	0.25 (<0.001)	1.13
BRS	NS		NS	
Visual deficit	NS		NS	
Incontinence	NS		NS	
Neglect	–0.10(0.001)	1.17	NS	
Motor FIM at admission	0.37(<0.001)	2.31	–0.28 (0.003)	2.17
Cognitive FIM at admission	0.46 (<0.001)	1.20	0.56 (<0.001)	1.97

BRS, Brunnstrom stage (sum of scores at the upper limb, fingers, and lower limb); FIM, Functional Independence Measure; MRFS, Montebello Rehabilitation Factor Score; NS, not significant; VIF, variance inflation factor.

Table 5 Multivariate logistic linear regression analysis for home discharge

		Home discharge	
		OR (95%CI)	*P*
Age at admission			NS
Gender	Male	1.00	
	Female	0.13 (0.03–0.50)	0.003
Pre-stroke living situation	Alone	1.00	
	With spouse	2.52 (0.44–14.23)	0.301
	With family	23.25 (3.79–142.56)	0.001
Medical complication			NS
Onset			NS
Stroke type			NS
Premorbid independence (premorbid mRS 0–2)	Yes	1.00	
	No	0.09 (0.02–0.37)	0.001
BRS			NS
Visual deficit			NS
Incontinence			NS
Neglect	No	1.00	
	Yes	0.04 (0.01–0.27)	0.001
Motor FIM at admission			NS
Cognitive FIM at admission		1.12 (1.03–1.22)	0.010

mRS, modified Rankin Scale; BRS, Brunnstrom stage (sum of scores at the upper limb, fingers, and lower limb); FIM, Functional Independence Measure.